Small Business Innovation Research/Small Business Tech Transfer

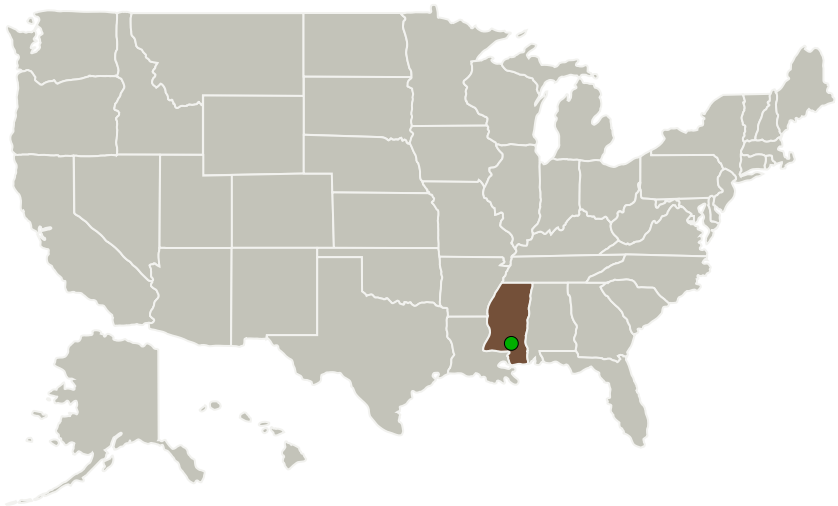
An Affordable Autonomous Hydrogen Flame Detection System for Rocket Propulsion, Phase I

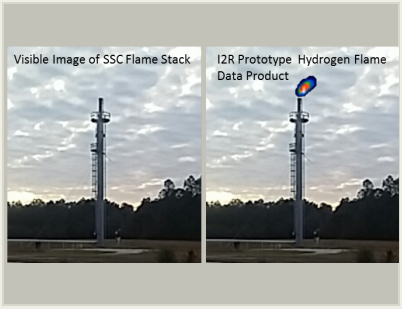
Completed Technology Project (2017 - 2017)

Project Introduction

NASA has long used liquid hydrogen as a fuel and plans to continue using it in association with their advanced nuclear thermal propulsion technology. Hydrogen fire detection is critical for rocket propulsion safety and maintenance. A significant fire at a rocket test or launch facility could be catastrophic to infrastructure or even worse, to human life. Detection monitoring is problematic as hydrogen flames can be nearly invisible during the day. Non-imaging, non-visible fire detection technology has limited range and can suffer from false alarms from sources outside the region of interest. Low-cost visible imagers, commonly used for wide-scale routine surveillance, have limited utility detecting hydrogen fires. Although it has been known for decades that multispectral imaging outside the visible range can be used to detect fires with low false alarm rates, the price of such systems and the lack of processing algorithms and the ability to implement them in real-time has largely prohibited their use. During this project we will develop a low-cost imaging capability that fuses data collected from sensors operating in the (1) solar blind ultra-violet, (2) thermal infrared and (3) visible spectrum, using advanced spectral, spatial and temporal processing techniques optimized to detect and generate alerts associated with hydrogen fires in real-time. This multi-sensor, multi-processing approach will enable us to automate flame detection with extremely low false alarm rates. In addition to control room alerts, we will make use of the wireless communication capabilities found within smart phones and other mobile devices to build an App to alert key decision makers and first responders of a fire detected in real-time. This multi-sensor imaging research could also support NASA's important cool flame microgravity research occurring on the International Space Station.

Primary U.S. Work Locations and Key Partners





An Affordable Autonomous Hydrogen Flame Detection System for Rocket Propulsion, Phase I Briefing Chart Image

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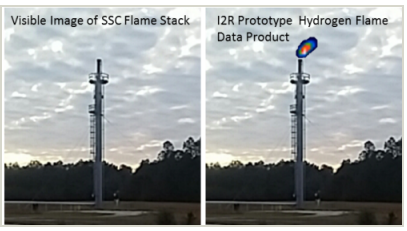
Organizations Performing Work	Role	Type	Location
Innovative Imaging and Research Corporation	Lead Organization	Industry Women-Owned Small Business (WOSB)	Stennis Space Center, Mississippi
Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi

Primary U.S. Work Locations
Mississippi

Images



Briefing Chart Image
An Affordable Autonomous Hydrogen Flame Detection System for Rocket Propulsion, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/134074)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Innovative Imaging and Research Corporation

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

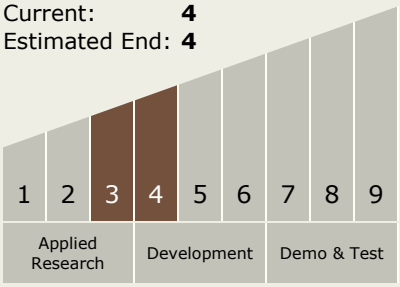
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Mary A Pagnutti

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  - TX13.2 Test and Qualification
    - TX13.2.2 Propulsion, Exhaust, and Propellant Management